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THE MELTING RATIO.

BY MR. ARCH M. LOUDON, NEW YORK.

From the reports in the technical press I note that in the November meeting of the Foundrymen's Association of Philadelphia, the melting ratio was thoroughly discussed. This is a step in the right direction, for I believe the financial success of a foundry, at the present time, more so than ever in the history of the industry, necessitates the closest attention on the part of the management to the individual economies.

I was pleased to read the experience of Mr. G. D. Moore, who made a careful 60 days test of 25 tons daily heats, and got an average ratio of 9 to 1 His results, as given, are consistent with good management. Another gentleman, giving his experience, voiced the condition of many foundries where they "think" they get 10 to 1, but have no means at hand to actually prove what they do get.

Now taking the cost of fuel to melt at 7 to 1, and taking 25 tons per day for 300 days, or 7,500 tons of castings per year, this means 3.57 times 300 days, or 1,071 tons of fuel per year. With fuel at $5.00, $5,355 is the amount consumed. With a ratio of 10 to 1 and the same tonnage, the fuel bill would be only $3,750, showing a profit of $1,605, and from the experience of the writer almost every foundryman running a jobbing foundry with one kind of iron should easily make this saving.

Here is a twenty ton heat with 43 per cent. steel scrap. 1,000 lbs. coal, and 500 lbs. coke was used for the bed. 8,200 lbs. was the first charge, with 4,000 pound charges thereafter. Eight charges being made with 375 lbs. coke between. Total fuel 4,500 lbs. The melting ratio was almost 9 to 1, and the metal had to be held 35 minutes in the ladle before pouring.

I give this experience in order to invite criticism, and hope that further data from others interested in this subject may be offered for a more extended discussion.

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MALLEABLE CAST IRON.

BY H. E. DILLER, CHICAGO, ILL.

Much has been written of late in the way of calling attention to the rapid growth of the Malleable Casting Industry, and, indeed, not only are new works springing up in the large iron centres, but the older establishments are expanding very materially. There is little wonder at this when it is considered that the malleable casting is peculiarly adapted to the requirements of four great classes of work; agricultural implements, railway supplies, carriage and harness castings, and pipe fittings. Were it not for the fact that malleable cast iron is not adapted to the heavier sections, it would be a sharp competitor to the gray casting industry.

In its manufacture the special make of iron called "Malleable Bessemer," or "malleable coke iron," is the principal material used. The charcoal irons, though unequalled for value, being confined to the regions where they can compete with the cheaper coke irons. The Silicon should be .75 to 1.50 per cent., phosphorus under .200 per cent., while sulphur should be below .04 per cent. if possible. A pig iron, higher in sulphur, in reality an "Off-Bessemer," while meeting the silicon specifications perfectly, should not be used except in limited quantity, and then carefully watched.

With the pig iron, hard sprues (unannealed scrap), steel and also malleable scrap is charged. The latter two materials are very good to add to the mixture as they raise the strength of the casting very considerably. Care must be taken not to add too much, as this reduces the carbon to a point when fluidity and life in the melted metal is sacrificed.

"Malleable" is produced in the cupola, the reverberatory furnace, and the open hearth. The first process, under ordinary conditions, is the cheapest. The iron made is, however, by no means the best. Test bars made of cupola iron seldom run above 40,000 lbs. per sq. in., while with furnace iron there is no difficulty in getting a few thousand pounds more. The most serious objec-

tion to cupola iron is its poor behavior under the bending test, the deflection being very light.

In the reverberatory and in the open hearth, the fuel is not in contact with the metal and the result is much more satisfactory. The metal in these furnaces may either be caught in the ordinary hand ladles or it is tapped into a large crane ladle and conveyed to the distributing point and there emptied into hand ladles as required. When tapped into hand ladles, the time taken is a serious item, for the beginning and the end of the heat will be two different things. The latter iron especially will be inferior, as it was subjected to the oxidising effects of the flame much longer than the first part. As a rule this difficulty is somewhat remedied by pouring the light work first, the heavier pieces coming later, when the silicon has been lowered too much for good light castings. With the crane ladle pour the molder has much less space to travel over, and this will doubtless be the coming method.

It takes a good man in the foundry as well as in the pattern shop to handle malleable casting questions properly. The gating should be done to avoid the shrinkage effects as much as may be, while the little tricks that can be applied make a surprising difference in the molding loss. As a consequence some malleable works seldom lose more than 10 per cent., while in others 20 per cent. and over is the rule.

After the castings have been tumbled they go to the annealing room, where they are packed in mill cinder or iron ore, in cast iron boxes. These are carefully luted up, and heated up in suitably constructed ovens for the space of five or six days. It usually takes 36 to 48 hours to get the oven up to heat, the temperature ranging from 1600° to 1800° F. in the oven, the boxes having a somewhat lower temperature at the coldest point. When the fire is extinguished, the dampers are closed tight, all air excluded and the oven allowed to cool very gradually, often but 400° F. the first day. After the castings come from the anneal, they are again tumbled to remove the burnt scale, and they are chipped and ground for shipment.

The hard casting should have its carbon practically all in the combined state, while annealing process should convert this to the so-called Temper, or annealing carbon. A well annealed casting should not have much over .06 to .12 per cent combined car-

bon remaining in it. Under-annealed castings can be readily detected by their brittleness, but it takes much experience to be sure that a casting is over-annealed. There is a material difference between the strength of an over-annealed casting and a normal one. I took two bars from each of five heats. One bar from each set I gave the usual anneal; and the others I re-annealed. The average tensile strength of the first set was 50,520 lbs. per sq. in., and the average elongation was 6¾ per cent. in six inches. The re-annealed set had an average tensile strength of 43,510 lbs. per sq. in., the average elongation being 6¼ per cent. in six inches. Over-annealing had therefore cost the metal some 7,000 lbs of its strength.

The fact that malleable castings are little understood may account for the limited way in which they are specified. While some rail roads specify the mixture, composition, and strength of gray castings, they do little in the way of the malleable. One rail road for which I made castings called for 40,000 lbs. per sq. in., and an elongation of 5 per cent. in two inches, for sections ½" and under. and 30,000 lbs. per sq. in. with a corresponding elongation of 2½" for sections ¾" to 1" thick.

To show to what degree some foundries are making iron for these demands, I took test pieces from some of their castings. The tensile strength and elongation, in six inches, of these pieces was as follows :

No.	1.	35,030	lbs. per sq. in.,	and	4.7	per cent.	elongation.
"	2.	34,410	" "	"	3.3	"	"
"	3.	37,840	" "	"	4.2	"	"
"	4.	45,550	" "	"	4.0	"	"

It was also rather odd that the thicker pieces showed the better iron, for usually founders err in the pouring of heavy castings with mixtures intended for light work.

"Malleable" can be made up to 60,000 lbs. per sq. in., though this is not advisable as the shock resisting qualities are sacrificed. Yet as specifications become more severe the general quality of this class of castings will be improved until we get a more reliable article, and which can better resist the encroachments of the steel casting.